



THE SPEED OF LIGHT

A NASA Train Like An Astronaut Mission Handout – Instructor Guide

Learning Objectives

Students will:

- perform a time reaction activity using a ruler to practice your concentration and improve your hand-eye reaction time; and
- record observations about improvements in this skill-based experience in the Mission Journal.

Introduction

Have you ever played a quick moving sport such as basketball, tennis, or racquetball? As with most sports, these physical activities require you to be quick on your feet and stay focused. Thinking quickly about your next move takes a lot of practice and perseverance if you want to improve your game.

Each time you practice a sport or repeat the same physical activity, you are improving your reaction time. Reaction time is how fast you can respond to a stimulus. A stimulus is defined as something that causes a physical response, it can be; a noise or something you feel or see. Astronauts practice their mission duties on Earth to improve reaction time and concentration to be prepared for their mission.

NASA has a variety of environments where astronauts train for their missions. They prepare for their mission duties on Earth in order to improve their physical stamina which increases their reaction time. This also prepares them mentally which improves their concentration. NASA simulates unforeseen situations and events to help the astronauts prepare for the unexpected in space. Astronauts preparing for Extra-Vehicular Activities (EVAs) or robotic arm operations assess their skills in the Virtual Reality Laboratory (VR) at the Johnson Space Center (JSC). This lab simulates the microgravity environment of space. Astronauts wear special gloves, video display helmets, chest packs, and controllers, to learn how to orient themselves in space. In space, the directions of up and down are not recognized and even a minor tweak with a thruster can send the astronaut spinning off into space. Astronauts practice getting acclimated to space as well as practice dangerous events such as self-rescue techniques during an EVA in the safety of the VR Lab. Preparation on Earth helps the astronauts have successful EVAs in space.

Another astronaut training center is the Jake Garn Training Center which is also located at the Johnson Space Center. At this training facility astronauts prepare for space shuttle operations. A motion-based training simulator, imitates the trip into space. Vibrations, noise, and views that the astronauts experience during a space shuttle launch or landing are just part of the simulation. The Jake Garn facility also houses a functional space station simulator which astronauts use to familiarize themselves with the laboratory systems of the International Space Station (ISS).

Space shuttle and ISS trainers and instructors at this facility introduce the astronauts to various situations they may encounter on their missions. Space shuttle pilots understand the importance of reaction time and concentration especially since they are required to land the space shuttle safely. Space shuttle pilots practice on Earth in simulators for many hours. They are presented

with various landing situations and practice landing the space shuttle safely and successfully. Astronauts depend on their reaction time and concentration in order to have a successful shuttle mission.

Administration

Follow the outlined procedure in The Speed of Light Mission Handout. The duration of this physical activity can vary, but will average **30-45** minutes per class.

Location

This physical activity should be conducted in an area which is flat and dry. It could be done in a classroom with limited distractions.

Set-up

- If sitting, position two chairs directly across from each other. One chair for each student in a team of two.
- Give each student their mission handout either on a clip board or have them sit close to a desk to place their mission handout on while they are engaged in the activity.
- Print or display a copy of the Distance and Time Chart (Appendix A)

Equipment

- Mission Handout
- Mission Journal and pencil
- Metric rulers – wood, hard plastic, or metal

Safety

- Sit or stand in a comfortable position during the activity.
- Use tools and equipment in the appropriate manner.
- Avoid obstacles, hazards, and uneven surfaces.
- Wear appropriate clothes and shoes that allow you to move freely and comfortably.

Monitoring/Assessment

Ask the Mission Question before students begin the physical activity. Have students use descriptors to verbally communicate the answers.

Use the following open-ended questions **before, during, and after** practicing the skill-based activity to help students make observations about their own skill level and their progress in this skill-based activity:

- Are your trial scores improving as you are practicing?
- Was your first and last trial different? If they were, what do you think played a factor in making both trials different?
- If your reaction time did not increase, what can you do to make your reaction time faster?

Some quantitative data for this skill-based activity may include:

- changes in trial scores
- how many trials were performed over the course of the class

Some qualitative data for this skill-based activity may include:

- environmental factors
- student fatigue level
- identifying discomfort in body parts

Collect, Record, and Analyze Data

Students should record observations about their skill-based experience in their Mission Journal before and after the activity. They should also record their skill-based goals and enter qualitative data for drawing conclusions.

- Monitor student progress throughout the skill-based activity by asking open-ended questions.
- Time should be allotted for the students to record observations about their experience in their Mission Journal before and after the skill-based activity.
- Graph the data collected in the Mission Journal on the graph paper provided by the teacher. Letting students analyze the data individually. Share graphs with the group and then discuss as a class.
- Find a mean, median, and mode of your reaction times.

Apply mathematics! Convert the centimeters to millimeters.

http://www.onlineconversion.com/length_common.htm

Students should practice the Mission Handout physical activity several times before progressing or trying the related Fitness Acceleration and Mission Explorations.

Fitness Acceleration

- Squeeze a stress relief ball 30 seconds and then try the Speed of Light activity. Did this affect your reaction time? Explain.
- Ride in an elevator while doing the ruler catch activity. Did this affect your reaction time? Explain.
- Do twenty jumping jacks, and then try the Speed of Light activity. Did this affect your reaction time? Explain.

Mission Explorations

- Practice a video or computer game that requires quick decision making.
- Participate in quick-moving sports such as volleyball, tennis, table-tennis, or racquetball.
- Visit an internet site approved by your teacher that has a reaction time test. Some involve changing lights, sounding buzzers, and even driving cars.

National Standards

National Physical Education Standards:

- Standard 1: Demonstrates competency in motor skills and movement patterns needed to perform a variety of physical activities.
- Standard 2: Demonstrates understanding of movement concepts, principles, strategies, and tactics as they apply to the learning and performance of physical activities.

National Health Education Standards (NHES) Second Edition (2006):

- Standard 5: Students will demonstrate the ability to use decision-making skills to enhance health.
 - 5.5.4 Predict the potential outcomes of each option when making a health related decision.
 - 5.5.6 Describe the outcomes of a health related decision.
- Standard 6: Students will demonstrate the ability to use goal-setting skills to enhance health.
 - 6.5.1 Set a personal health goal and track progress toward its achievement.

National Initiative

Local Wellness Policy, Section 204 of the Child Nutrition and WIC Reauthorization Act of 2004 may be a valuable resource for your Student Health Advisory Council in implementing nutrition education and physical activity.

Resources

For more information about space exploration, visit www.nasa.gov.

To learn about exercise used during past and future space flight missions, visit <http://www.nasa.gov/centers/johnson/slsd/about/divisions/hacd/index.html>

Access fitness-related information and resources at www.fitness.gov.

View programs on health and fitness:

Scifiles™ The Case of the Physical Fitness Challenge

<http://www.knowitall.org/nasa/scifiles/index.html>

NASA Connect™ Good Stress: Building Better Bones and Muscles

<http://www.knowitall.org/nasa/connect/index.html>

NASA Connect™ The Right Ration of Rest: Proportional Reasoning:

<http://www.knowitall.org/nasa/connect/index.html>

NASA Connect™ Better Health From Space to Earth

<http://www.knowitall.org/nasa/connect/index.html>

Credits and Career Links

Lesson development by the NASA Johnson Space Center Human Research Program Education and Outreach team with thanks to the subject matter experts who contributed their time and knowledge to this NASA Fit Explorer project.

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Astronaut Strength, Conditioning & Rehabilitation (ASCR) Specialists

NASA Johnson Space Center

<http://www.wylelabs.com/services/medicaloperations/ascr.html>

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<http://www.nasa.gov/centers/johnson/slsd/about/divisions/hacd/project/exercise-countermeasures.html>

Distance	Time
5 cm (2 in)	100 ms (0.10 sec)
7.5 cm (3 in)	120 ms (0.12 sec.)
10 cm(4 in)	140 ms (0.14 sec)
12.5 cm(5 in)	160 ms(0.16 sec)
15 cm(6 in.)	180 ms (0.18 sec)
17.5 cm(7 in)	190ms (0.19sec)
20 cm (8 in)	200 ms (0.20 sec)
22.75 cm (9 in)	220ms(0. 22 sec)
25.5 cm (10 in)	230 ms (0.23 sec)
27.5 cm (11 in)	240 ms (0.24 sec)
30.5 cm. (12 in.)	250 ms. (0.25 sec.)